CLAIMS

We claim:

Sub A1

1. A method of preheating a substrate which includes a metal-containing layer to a temperature of at least 150 °C, wherein said method comprises exposing said substrate to a preheating plasma which is sufficiently reactive with said metal-containing layer that a deposit or residue formed during preheating which includes metal from said metal-containing layer is more easily etched than said metal-containing layer during a subsequent plasma etching of said metal-containing layer, wherein said metal is selected from the group consisting of platinum, iridium, ruthenium, and combinations thereof..

2. The method of Claim 1, wherein said metal-containing layer is a platinum-containing layer and a first source gas used to produce said preheating plasma includes nitrogen.

3. The method of Claim 2, wherein said platinum-containing layer is platinum.

4. The method of Claim 2 or Claim 3, wherein said first source gas is at least 50 % by volume nitrogen.

5. The method of Claim 4, wherein a second plasma source gas used during subsequent plasma etching of said platinum-containing layer or said platinum layer is at least 15 % by volume nitrogen.

6. The method of Claim 1, wherein said metal-containing layer is a ruthenium-containing layer and a first source gas used to produce said preheating plasma includes a gas selected from the group consisting of nitrogen, oxygen, and combinations thereof.

7. The method of Claim 6, wherein said ruthenium-containing layer is ruthenium oxide.

8. The method of Claim 6, wherein said ruthenium-containing layer is ruthenium.

9. The method of Claim 7 or Claim 8, wherein said first source gas is at least 50 % by volume nitrogen.

10. The method of Claim 9, wherein said first source gas is nitrogen.

11. The method of Claim 7 or Claim 8, wherein said first plasma source gas is at least 50 % or more oxygen by volume.

12. The method of Claim 11, wherein said first plasma source gas is oxygen.

13. The method of Claim 9, wherein a second plasma source gas used during subsequent plasma etching of said ruthenium-containing layer is at about 70 % or more oxygen by volume.

14. The method of Claim 10, wherein a second plasma source gas used during subsequent plasma etching of said ruthenium-containing layer is about 70 % or more oxygen by volume.

15. The method of Claim 11, wherein a second plasma source gas used during subsequent plasma etching of said ruthenium-containing layer is at about 70 % or more oxygen by volume.

16. The method of Claim 12, wherein a second plasma source gas used during

subsequent plasma etching of said ruthenium-containing layer is about 70 % or more oxygen by volume.

17. The method of Claim 1, wherein said metal-containing layer is an iridium-containing layer and a first source gas used to produce said preheating plasma includes a gas selected from the group consisting of nitrogen, oxygen, and combinations thereof.

18. The method of Claim 17, wherein said iridium-containing layer is iridium oxide.

19. The method of Claim 17, wherein said iridium-containing layer is iridium.

20. The method of Claim 18 or Claim 19, wherein said first source gas is at least 50 % by volume nitrogen.

21. The method of Claim 20, wherein said first source gas is nitrogen.

22. The method of Claim 18 or Claim 19, wherein said first plasma source gas is about 50 % or more oxygen by volume.

23. The method of Claim 22, wherein said first plasma source gas is oxygen.

24. The method of Claim 20, wherein a second plasma source gas used during subsequent plasma etching of said iridium-containing layer is at about 70 % or more oxygen by volume.

25. The method of Claim 21, wherein a second plasma source gas used during subsequent plasma etching of said iridium-containing layer is at about 70 % or more

oxygen by volume.

26. The method of Claim 22, wherein a second plasma source gas used during subsequent plasma etching of said iridium-containing layer is at about 70 % or more oxygen by volume.

27. The method of Claim 23, wherein a second plasma source gas used during subsequent plasma etching of said iridium-containing layer is at about 70 % or more oxygen by volume.

28. A method of plasma heating a substrate and etching a platinum-containing layer included in said substrate, said method comprising:

a) supplying a first nitrogen-comprising plasma source gas to a process chamber containing said substrate;.

b) preheating said substrate to a temperature of at least 150 °C using ion bombardment from a plasma generated from said first nitrogen-comprising plasma source gas;

c) supplying a second nitrogen-comprising plasma source gas to said process chamber; and

d) forming a plasma from said second nitrogen-comprising source gas to etch said platinum-containing layer while removing platinum-comprising deposits generated during said preheating of said substrate.

29. The method of Claim 28, wherein said first nitrogen-comprising plasma source gas contains at least 50 % nitrogen by volume.

30. The method of Claim 29, wherein said first nitrogen-comprising plasma source gas is nitrogen.

31. The method of Claim 28 or Claim 29, wherein said second nitrogen-comprising plasma source gas contains about 15 % or more nitrogen by volume.

32. The method of Claim 31, wherein said second nitrogen-comprising plasma also includes at least one inert, non-reactive gas selected from the group consisting of helium, neon, argon, krypton xenon, and combinations thereof..

33. A method of plasma heating a substrate and etching a ruthenium-containing layer included in said substrate, said method comprising:

a) supplying a first plasma source gas comprising a gas selected from the group consisting of nitrogen, oxygen, or combinations thereof into a process chamber containing said substrate;.

b) preheating said substrate to a temperature of at least 150 °C using ion bombardment from a plasma generated from said first plasma source gas;

c) supplying a second plasma source gas comprising oxygen to said process chamber; and

d) forming a plasma from said second source gas to etch said ruthenium-containing layer while removing ruthenium-comprising deposits generated during said preheating of said substrate.

34. The method of Claim 33, wherein said ruthenium-containing layer is ruthenium oxide.

35. The method of Claim 33, wherein said ruthenium-containing layer is ruthenium.

36. The method of Claim 34 or Claim 35, wherein said first source gas is at least

50 % by volume nitrogen.

37. The method of Claim 36, wherein said first source gas is nitrogen.

38. The method of Claim 34 or Claim 35, wherein said first source gas is about 50 % or more oxygen by volume.

39. The method of Claim 38, wherein said first plasma source gas is oxygen.

40. The method of Claim 36, wherein said second plasma source gas used during subsequent plasma etching of said ruthenium-containing layer is at about 70 % by volume or more oxygen.

41. The method of Claim 37, wherein said second plasma source gas used during subsequent plasma etching of said ruthenium-containing layer is about 70 % by volume or more oxygen.

42. The method of Claim 38, wherein said second plasma source gas used during subsequent plasma etching of said ruthenium-containing layer is at about 70 % by volume or more oxygen.

43. The method of Claim 39 wherein said second plasma source gas used during subsequent plasma etching of said ruthenium-containing layer is about 70 % by volume or more oxygen.

44. A method of plasma heating a substrate and etching an iridium-containing layer included in said substrate, said method comprising:

a) supplying a first plasma source gas comprising a gas selected from the

group consisting of nitrogen, oxygen, and combinations thereof into a process chamber containing said substrate;.

b) preheating said substrate to a temperature of at least 150 °C using ion bombardment from a plasma generated from said first plasma source gas;

c) supplying a second plasma source gas to said process chamber; and

d) forming a plasma from said second source gas to etch said iridium-containing layer while removing iridium-comprising deposits generated during said preheating of said substrate..

45. The method of Claim 44, wherein said second source gas includes oxygen.

46. The method of Claim 44 or Claim 45, wherein said iridium-containing layer is iridium oxide.

47. The method of Claim 44 or Claim 45, wherein said iridium-containing layer is iridium.

48. The method of Claim 44, wherein said first source gas is at least 50 % by volume nitrogen.

49. The method of Claim 44, wherein said first source gas is about 50 % or more oxygen by volume.

50. The method of Claim 45, wherein said second plasma source gas used during subsequent plasma etching of said iridium-containing layer is at about 70 % by volume or more oxygen.

51. The method of Claim 46, wherein said second plasma source gas used during

subsequent plasma etching of said iridium-containing layer is about 70 % by volume or more oxygen.

52. The method of Claim 47, wherein said second plasma source gas used during subsequent plasma etching of said iridium-containing layer is at about 70 % by volume or more oxygen.

53. The method of Claim 48, wherein said second plasma source gas used during subsequent plasma etching of said iridium-containing layer is at about 70 % by volume or more oxygen.

54. The method of Claim 49, wherein said second plasma source gas used during subsequent plasma etching of said iridium-containing layer is at about 70 % by volume or more oxygen.

55. The method of Claim 50, wherein said second plasma source gas includes an inert, non-reactive gas selected from the group consisting of helium, neon, argon.

56. The method of Claim 51, wherein said second plasma source gas includes an inert, non-reactive gas selected from the group consisting of helium, neon, argon.

57. The method of Claim 52, wherein said second plasma source gas includes an inert, non-reactive gas selected from the group consisting of helium, neon, argon.